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The Classroom Performance System and the Teaching and Learning of Mathematics

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Abstract

The teaching and learning of mathematics often involves a lot of drill and practice questions. Teachers are burdened with the marking of questions with one numeric value responses. The essence of the exercises are not merely for pupils to practice but also for the teacher to be able to determine the area of weakness or difficulty of the pupils' in mathematics and provide appropriate feedback and support. Teachers with all the extra work given often do not have the time or energy to analyse every exercise. In fact marking is often done a week once or even a month once and sometimes the teacher provides the answers and requests the pupils to mark the numerous questions. Today a 21st century tool called "Classroom Performance System" enables pupils to key in every numeric value answer to given questions and the marking is done instantly and so is the analysis. This paper describes a priori study on the effects of the use of the Classroom Performance System in the teaching and learning of mathematics in Malaysia. The study involves 20 primary school pupils in a Malaysian Primary school who face difficulty memorising their times tables.

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1. Introduction

Every teacher uses some form of informal formative assessment in class. Most teachers will ask a few questions to probe background knowledge that serve as pre-requisites for the topic that they would be teaching for the lesson. Often, informal formative assessment in class is conducted with the posing of a few questions and the receiving of a few correct responses in the class. This is then followed by an overall class response of "Yes", to the popular question, "Do you all understand?" This is perceived as all pupils having knowledge of the required pre-requisite. During the lesson and after the lesson, the same procedure is followed to affirm that at every stage all the pupils had followed and understood the lesson. This "gimmick" is a trend in most classes and the downfall of the purpose of the informal formative assessment which is meant to serve as a guide to prepare corrective activities that focus on pupils' learning difficulties and to improve ineffective teaching activities. The teachers use appropriate questions to probe understanding. The pitfall lies in the impossible task of receiving responses from each and every individual pupil in class. Hence, the few correct responses within ear reach is perceived as the response from every pupil.

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Today this pitfall can be overcome by the use of a device called the Classroom Performance System (CPS) which enables each pupil to key in and submit their answers to their teacher's computer. The system also marks the responses and provides instant analysis of the data. Hence the teacher need not use the "gimmick" anymore and instead is able to obtain reliable information for taking the next appropriate action.

1.1 The Classroom Performance System (CPS)

According to Abrahamson (1999), people understand more by answering a question than by being told an answer. Abrahamson (1999) and other physicists created the Classroom Communication System (CCS) technology to enable teachers to teach interactively in the normal class sizes but yet be able to create a one-to-one ratio communication environment that would be ideal for instruction. The CCS called the CPS in this research is also known by other names such as Personal Response System, Audience Response System or Technology, Pupil Response System, response pads, wireless-keypads and "clicker" (Flynn and Russell, 2008; MacGeorge et al, 2007). The CPS is an emerging technology which enables everyone in a large class to be actively involved in learning by responding to questions or by sharing opinions. The extensive use of technology in the classroom assessment at present is mainly used to automate processes such as marking and analyzing so as to make the administrative burden of the teacher lighter. However, if these processes can be done instantly in the classroom while teaching then the technology will also provide invaluable information to refine and enhance the quality of instruction. This is exactly what the CPS is claimed to be capable of doing (Flynn and Russell, 2008). The CPS consisting of a wireless device networked to a central computer (the teacher's computer) can provide instant feedback to pupils' responses to objective questions in the class and hence is claimed to serve both purposes – reduce administrative burden of teachers and provide information to enhance quality of instruction.

1.2 Strategies to memorise times tables in school

The aim of the study was to determine the effects of the use of the CPS on pupils who were claimed to be unable to memorize all their basic multiplication facts better known as the times tables. The teachers in the school had tried various traditional strategies to enable these pupils to memorise their times tables but had failed.

Among the traditional strategies to enable these pupils to memorise their times tables was asking pupils to recite their times tables and obtain a tick on their times tables record card. The times table record card is a card given to every pupil every year to ensure that they memorise all their times tables. This method is a one-to-one, face to face, time consuming method. The tick is given when pupils manage to memorise one complete table, for example, the two times table. Even if the pupil has memorised more than one table the teachers could not afford the time to listen to every one on the same day. The monotonous nature of the task added to the lack of interest among teachers in assessing the pupils.

Another method used was giving the times table tests. The teachers claimed that many pupils tend to go off-task very quickly, that is, will not be engaged in doing the tests. They may write the answers for a few questions but after that they just write nothing or write wrong answers without any attempt to obtain the correct answer. Again analysing the data after giving the assessment was rarely done and often pupils were asked to check their own answers against the teacher's answers. This may have further discouraged pupils from making an effort because their teachers were unaware of their performance. Hence, effort was made by the teachers but all the methods failed to enable the pupils to memorise their times tables.

2. The Study

This study investigates the effects of the use of the CPS in a mathematics lesson that aimed at drilling a class of pupils in memorising their times tables. The study was designed to make use of the analysed data to employ alternative instructions to achieve the objective of memorising the times tables. The study also aimed at observing the use of the CPS on keeping pupils engaged to complete the assessments. This was vital because the study employed a series of tests.

Subjects: Twenty (later 18) eleven year old Year 5 pupils from a semi-urban primary school in Malaysia were participants of this study. The 20 pupils were identified by the mathematics teachers of the school as generally low achieving students who had difficulty in been engaged on task for more that 15 minutes. In the five years they had been in school the teachers claimed that these pupils had not memorised their times tables. However, no record of these pupils ability to recall their times tables were available. The pupils difficulties in memorising their times tables were basically illustrated in their errors in doing multiplication problems in their exercise books and test papers. However, these documents did not provide clear illustration of the specific times table or tables which posed difficulties for the pupils to memorise. Hence the study was designed assuming that these pupils did not know all their times tables.

Method: The 20, Year 5 pupils were seated apart in the school computer laboratory. Each pupil was given a response pad to communicate with the teacher's computer and a blank sheet of paper to do any working they wanted. They had to login and their presence was immediately recognised on the teacher's computer screen because each response pad has its own number and we had assigned a specific response pad to a specific pupil. The pupils were taught how to use the response pad. This took less than 10 minutes. All the students were capable of using the response pads correctly.

Then they were given the times table tests: 1, 2, 3, 4 and 5 times tables. The questions were displayed one by one on the screen using a Liquid Crystal Display projector and the pupils responded using their response pads. This took about 50 minutes to complete. A short 10 minutes break was given and then followed by the 6, 7, 8 and 9 times table tests which were conducted in the same manner as the earlier tests. This took about an hour to complete. Then a half hour recess was given.

During the recess, the data for the tests that were analysed by the CPS was viewed. Based on the data analysis the focus of the half hour teaching and learning session was decided to be the 6, 7, 8 and 9 times tables.

After the recess, the pupils were put in five groups of fours. Five trainee teachers, one assigned to each group taught different methods of recalling the times tables from 6 to 9. Then the pupils were given the 6, 7, 8 and 9 times table tests again, followed by a test where the times tables questions were mixed. The mixed test had 17 questions. The tests in all took about 50 minutes to be completed. No time frame was assigned to any of the tests.

Data Collection: All sessions were videotaped- the pupils taking the tests and the teaching and learning session. The test questions were displayed by a technical expert while I took field notes documenting the specific behaviour of the pupils during the tests and the teaching and learning sessions. Scores for each question was automatically obtained as the pupils submitted their answers using the response pads. The pupils were interviewed as a group to give their general views of the use of the CPS. The interview was also videotaped.

3. Findings

The four hours that was used for this research will be described in detail with the relevant quantitative and qualitative data.

The first 10 minutes of the study was teaching the 18 pupils how to use the response pads for answering the test questions. All students were able to comfortably use the response pads. When the study started, the pupils were to login. Four pupils who did not login were immediately called to do so. The teacher (the researcher) was informed that two pupils had left for the remedial class. The teacher then called the other two names to login and tagged the two absentees. In a class when a teacher's eyes are on the computer screen he/she would not know that a pupil had not followed instructions for an activity. However, this login requirement is able to alert the teacher of absentees and also keep record of the pupils in the class who are on and off task. (The absentees were marked absent and were no longer part of the study. This reduced the number of pupils to 18 pupils).

Then the one times table test was started by showing the question on the screen and the pupils' number keys were displayed on the screen as well. One question at a time was displayed. The subsequent question was displayed only after all the pupils had responded. The pupils' number keys changed colour when they had submitted their answers for the question posed. Hence, every pupil was engaged in the activity because they were aware that their participation was noted. Almost all the students used repeated addition to obtain their answers. However, two students who were always the first two were actually giving the response from recall. The students realised that the questions for each of the times tables were in sequence and so they keyed in their answers as soon as they had submitted the earlier answer and then did their addition for the next question. It was obvious they were having fun. Talking was not allowed. In any case, the pupils were too busy trying to be the first to give their response and so did not attempt to talk. They were aware that if they submitted first, then their number key would be the first to change colour and that the whole class would witness their speed. The teacher on the other hand, was provided the extra knowledge of every pupil's answer and whether the submitted answer is correct or incorrect. The class was a real demonstration of pupils participating without fear of embarrassment of giving the incorrect answer. Should this have been a class without the CPS, they would have been reluctant because everyone in class would hear or see (if it is written on the board) their answer. Normally pupils who have no confidence in their answer will choose not to give an answer. However for the teacher, the response from every pupil is vitally important to determine the explicit description of the students' learning progress. Hence again the CPS has enabled to obtain this vital information from the pupils without any difficulty.

After the one up to five times tables were covered, a break was given and the six up to the nine times tables tests were administered in the same manner as the one up to five times tables. Then the pupils went for their recess, during which time the data analysis done by the CPS was viewed. The analysis showed that most of the pupils were faring reasonably well in times tables one up to five. The group mean was 64 and 50% of the pupils' scores were between 50 percent (lower quartile) and 88 percent (upper quartile). Four pupils had a score above 90. As for the 25% below a score of 50% only 3 of them had real serious problems even with the 5 times table. The analysis for the 6 to 9 times tables showed a mean of 53% and 50% of the pupils' scores were between 37 percent (lower quartile) and 75 percent (upper quartile). However, there were two students who scored above 90. Both had high scores in the one to 5 times table tests – 80 and 91. Hence a clear description of pupils' ability to recall all their multiplication facts was available. Thus the data made it possible to focus on the times tables that posed greater problems for the pupils. Observation showed that pupils used the same repeated addition method to do the six to nine times tables. Hence, the numbers being larger resulted in more careless mistakes because pupils were not checking their answers as they did for the smaller numbers.

Based on these observations, the five trainee teachers were instructed not to teach the pupils to recall their times tables using repeated addition but to use any other method to recall the six up to the nine times tables. Three groups used the same method which will be referred to as method A and the other two groups used method B and method C. (Methods will not be described here as the focus of this study is not to compare these methods). The students were assigned randomly to the groups. After the teaching and learning session all the five trainees were requested to leave the classroom. The pupils were required to sit for their six to nine times table tests again. The data showed very slight difference in overall achievement of the 18 students. The mean score was 52 and 50% of the pupils' scores were between 33 percent (lower quartile) and 72 percent (upper quartile). In fact there was a slight drop. This may be due to tiredness from sitting for so many tests continuously. However, the point made from this data is that pupils were still engaged in doing the given task. The video revealed a very actively engaged class. Talking was not allowed during the tests. This should have bored them but the classroom situation did not indicate any signs of boredom nor frustration.

The final test was the mixed times tables test. The questions were basically from 6x6 to 6x9, 7x6 to 7x9, 8x6 to 8x9 and 9x6 to 9x9 and one additional question 7x8 was repeated. Hence a total of 17 questions made up the test. The mean score was 42% and 50% of the pupils' scores were between 18 percent (lower quartile) and 63 percent (upper quartile). It appears that the problem for the pupils in these multiplication facts was still persistent. Hence focus should be given to these multiplication facts rather than boring the students to recite the multiplication facts that they were already capable of obtaining through repeated addition accurately.

Methods A, B and C as a whole did not serve to enable pupils to do their times tables without repeated addition. However, the group under one trainee using Method A showed a very high mean score of 13.5 compared to the other 4 groups which ranged from 3 to 6.5. Whether the method and the teacher were better is not the point here. The significance is the fact that the difference in performance of the students using various methods and the skills of the teachers using the same method may be compared immediately from the data processed in the CPS. The method could be further explored and the skills of how the teacher explained the method could contribute to valuable professional development based on concrete data of the performance of his pupils witnessed by all who were present. This would contribute to enhance instruction quality.

The interview revealed that pupils enjoyed using the clicker. This was obvious with all pupils participating without a sigh for having to sit for so many tests within four hours of their six hours of learning for the day. They asked when a similar session would be conducted for them. The situation was definitely motivating.

Teachers who were present during the study expressed their wish to have the CPS in their school. They stated that they would definitely use it because it is easy to use and light to carry to class.

4. Conclusion

So what are the effects of the use of the CPS in the mathematics' lesson? One obvious effect is on the affective domain of pupils. Pupils enjoy using the response pad and it has a positive influence on their participation in class. Several studies make similar claim (Rice and Bunz, 2006; Nicol and Boyle, 2003). They claim that clickers have a positive influence on pupils' attention, interest and involvement in class.

Another effect of the CPS is that pupils will be engaged in the classroom activities. The two main reasons for this are that

- (i) they will realise that the teacher would know if they do not answer and she would call their name,
- (ii) their answers are revealed to no one except the teacher. This will motivate them to answer.

Hence pupils will be engaged on task giving their respective responses because the environment is non-threatening. This ability to engage every pupil is irrespective of class size (Mac George et al, 2007) which means that the teacher can facilitate interaction with every pupil during the lesson with the use of the CPS.

The CPS is able to analyse data instantly. The information from the analysis enables the teacher to take appropriate corrective measures to improve his/her instruction. The information also informs the teacher the area of difficulty of the pupils and this provides guidance to the teacher to focus on the relevant areas rather than blindly repeat everything. The "gimmick", "Do you understand" with a "Yes" response to probe pupils knowledge can be eliminated and replaced with an objective assessment using the CPS. Hence the CPS has the ability to have an effect on the teacher's instruction style and teaching quality if the teacher uses the data analysed by the CPS.

Many may argue that most computer based assessments can also provide data about pupils' ability and reduce administrative burden like the CPS for the teacher. The difference lies in the fact that the CPS based lesson is made up of one single computer and many small and light response pads compared to the many computers or laptops in a computer based lesson. In addition to this, the response pad is simple, user friendly with limited functions compared to the computers input devices, the key board and mouse. Hence, the CPS's portability and easy of use will have positive effect on teachers' willingness to conduct interactive classes with the CPS.

This study has shown that the CPS has many positive effects when used in the teaching and learning of mathematics. However, further research must be carried out to fully witness the ups and downs of the use of the CPS in real classroom situations.

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